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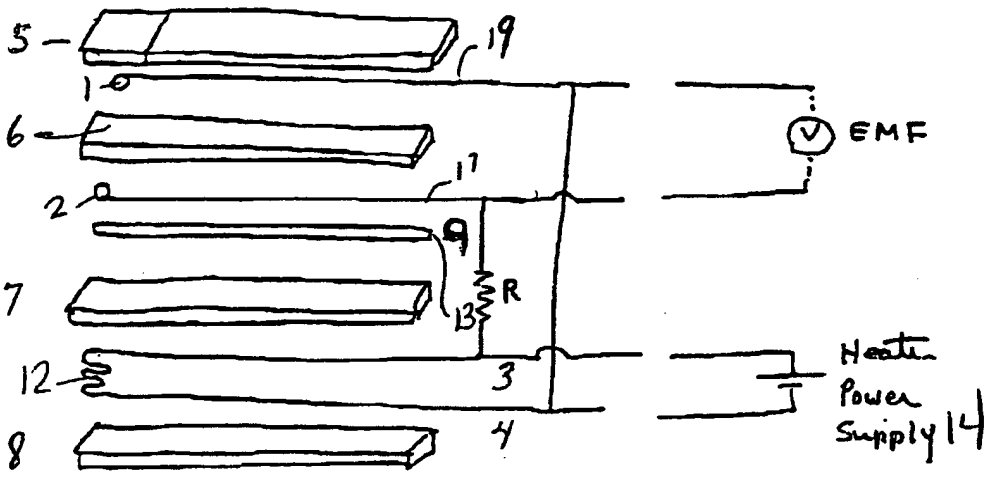
(54) Title: GAS SENSOR DESIGN AND METHOD FOR USING THE SAME



(57) Abstract: The gas sensor employs a reference gas channel which enables simultaneous or sequential pumping of oxygen and sensing of the exhaust gas (e.g., to determine if the exhaust gas is rich or lean). The method comprises: using a gas sensor comprising a first electrode and a reference electrode with an electrolyte disposed therebetween, wherein the first electrode and reference electrode are in ionic communication, and a reference gas channel in fluid communication with the reference electrode and an exterior of the sensor; introducing an exhaust gas to the first electrode; applying a voltage to the reference electrode; ionizing oxygen at the first electrode; transferring the ionized oxygen across the electrolyte to the reference electrode; forming molecular oxygen at the reference electrode; ionizing the molecular oxygen on the reference electrode; transferring the ionized oxygen across the electrolyte to the first electrode to create a voltage; and measuring the voltage.

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GAS SENSOR DESIGN AND METHOD FOR USING THE SAME

CROSSREFERENCE TO RELATED APPLICATIONS

This case claims the benefit of the filing date of the provisional application U.S. Provisional Application Serial No. 60/159,837 filed October 15, 1999, which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

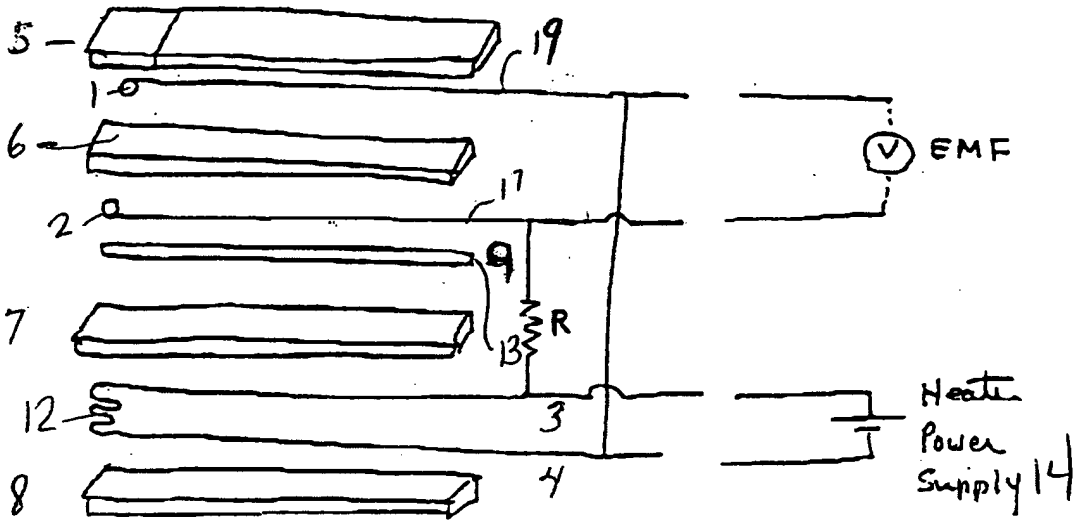
This invention relates to gas sensors, and, more particularly, to oxygen sensors.

BACKGROUND OF THE INVENTION

Oxygen sensors are used in a variety of applications that require qualitative and quantitative analysis of gases. In automotive applications, the direct relationship between the oxygen concentration in the exhaust gas and the air-to-fuel ratio of the fuel mixture supplied to the engine allows the oxygen sensor to provide oxygen concentration measurements for determination of optimum combustion conditions, maximization of fuel economy, and the management of exhaust emissions.

A conventional stoichiometric oxygen sensor typically comprises an ionically conductive solid electrolyte material, a porous electrode on the exterior surface of the electrolyte exposed to the exhaust gases with a porous protective overcoat, and an electrode on the interior surface of the sensor exposed to a known oxygen partial pressure. Sensors typically used in automotive applications use a yttria stabilized zirconia based electrochemical galvanic cell with platinum electrodes, which operate in potentiometric mode to detect the relative amounts of oxygen present in the exhaust of an automobile engine. When opposite surfaces of this galvanic cell are exposed to different oxygen partial pressures, an electromotive force is developed between the electrodes on the opposite surfaces of the zirconia wall, according to the Nernst equation:

Figure 1.



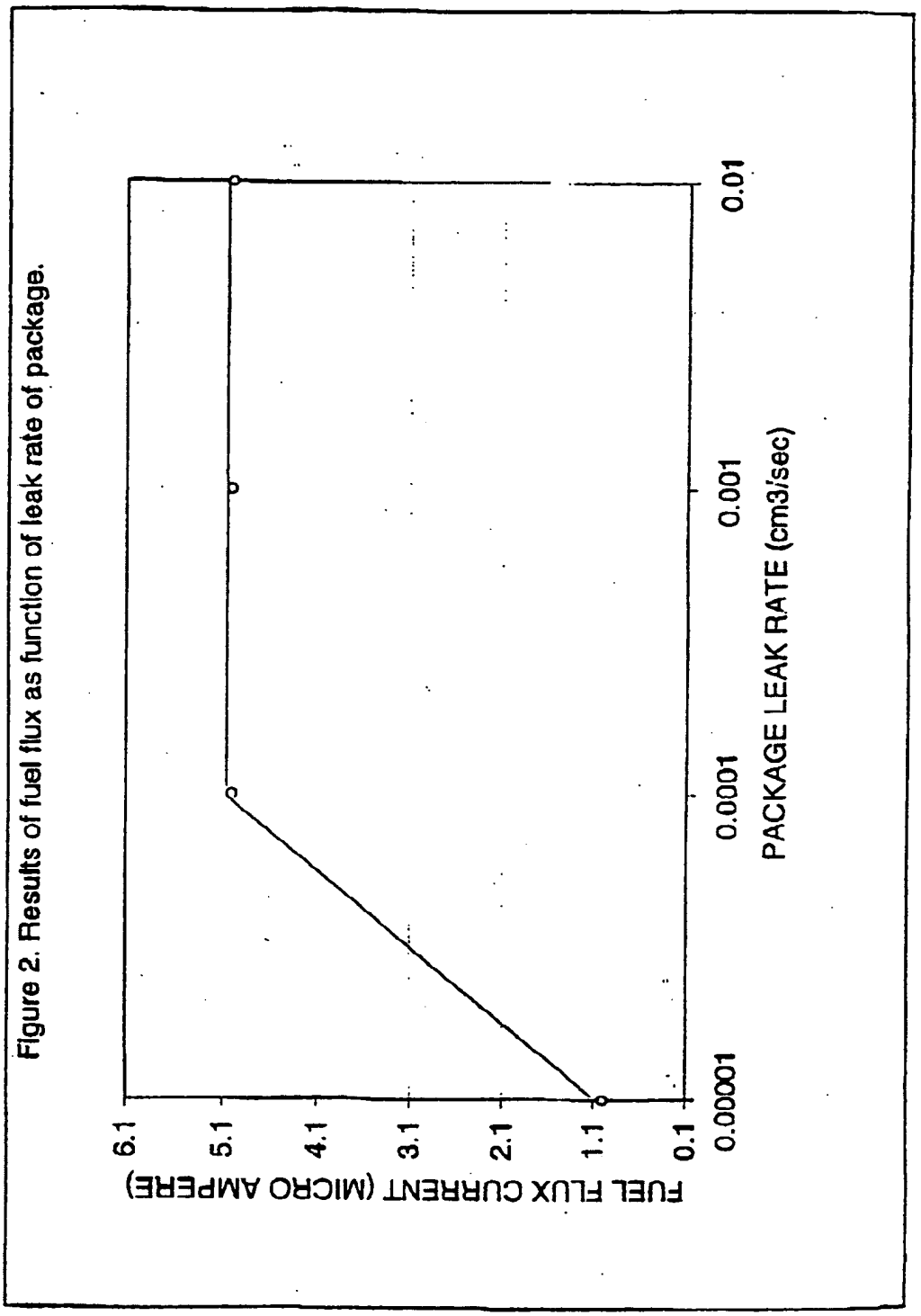


Figure 2. Results of fuel flux as function of leak rate of package.

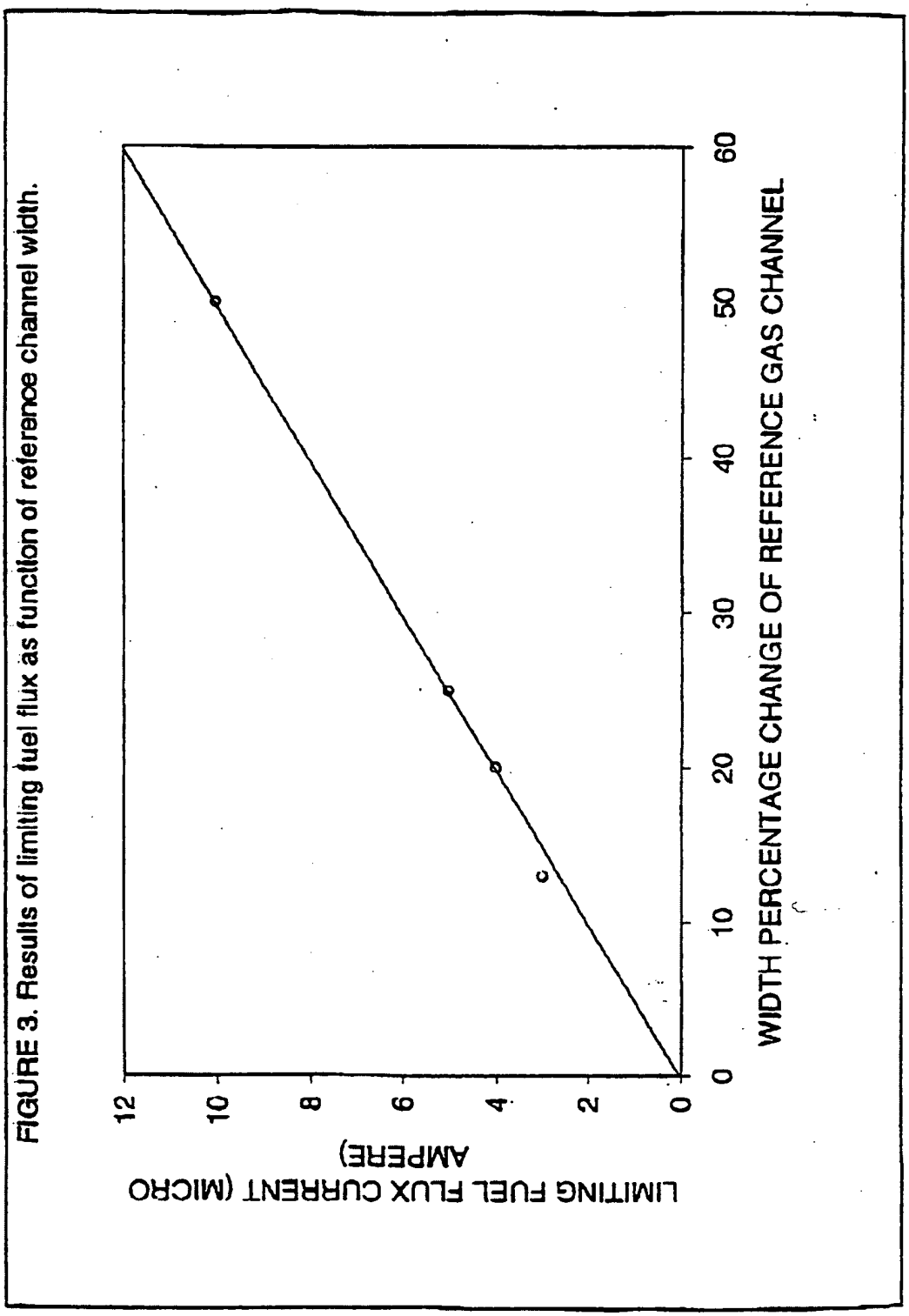


FIGURE 3. Results of limiting fuel flux as function of reference channel width.

Figure 4. Layout of gas channel for heater cycling condition

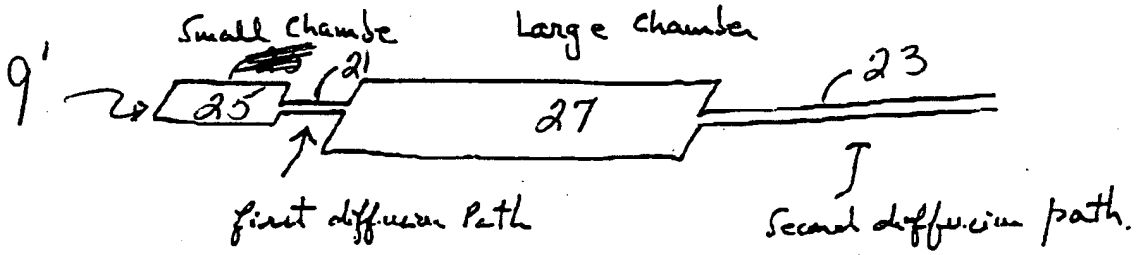


Figure 5. Alternative sensor layouts

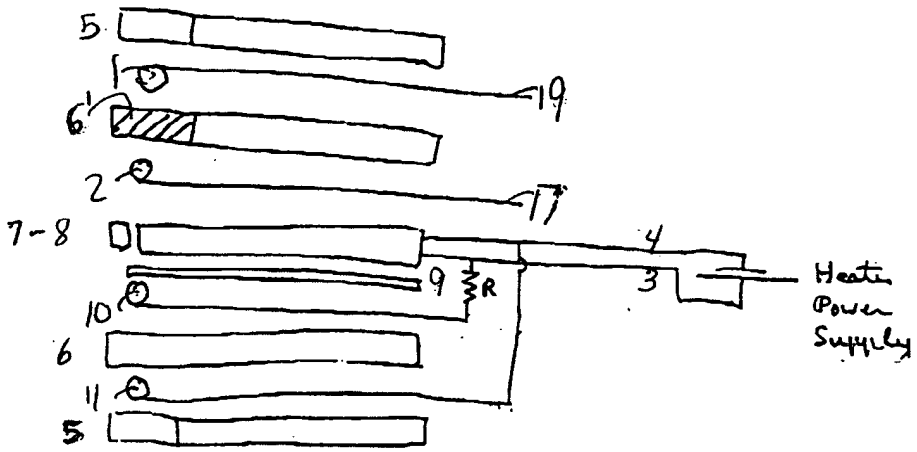


Figure 6

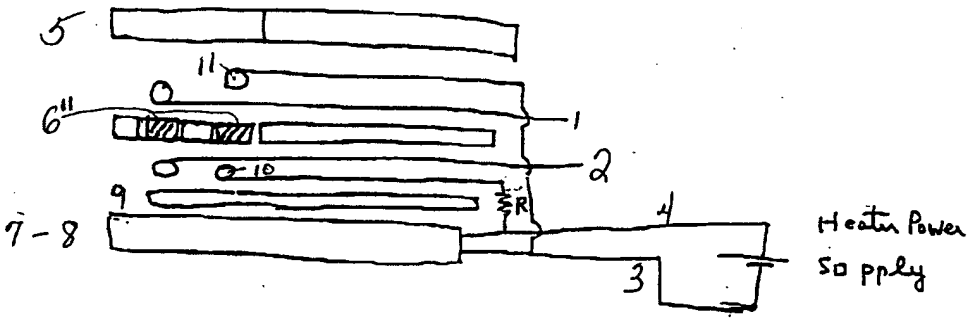


Fig. 7. ... with ground isolation feature.

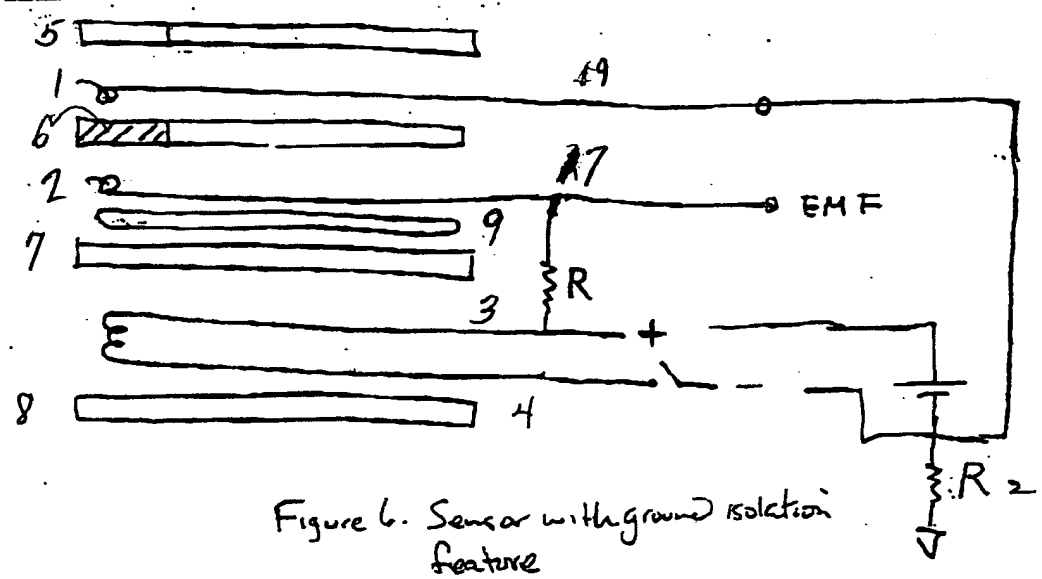


Figure 6. Sensor with ground isolation feature